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Introduction to Organic and Sustainable Agriculture Practices: Defining the Terms

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Organic Management Practices

The underlying strategy for organic and sustainable farm systems is to build soil quality, to promote ecological balance, and to conserve biodiversity. Organic crop production relies on using preventative management practices to reduce problems with weeds, diseases, pests and plant nutrition, and is done through integrating a variety of cultural, biological and mechanical management practices. This fact sheet will introduce and describe the management practices used in organic and sustainable cropping systems. In-depth fact sheets on the topics introduced here will provide more detailed information on each concept.



Soil

Biodiversity

Biodiversity refers to the variety of plant and animal life, both above and below ground, within the farm ecosystem. Organic cropping systems promote a diverse and balanced ecosystem as a practice to enrich the soil and to prevent weed, pest and disease problems. Crop rotations, crop diversity, farmscaping and intercropping

all are important components of farm biodiversity (see below).

Soil-Building

Healthy soil is the foundation of organic cropping systems. Organic systems build soil quality by increasing soil organic matter; promoting soil biological activity; and building soil fertility through management practices like incorporating compost, animal manures, cover crops and green manures. Soil-building is an ongoing process. Soil quality is maintained by regularly replenishing organic matter.

- **Soil Organic Matter:** Organic matter is the portion of the soil composed of plant and animal material in the process of decomposing.
- **Humus:** When organic matter has fully decomposed, it is called humus. Humus has a high nutrient-holding capacity. Healthy, productive soils have adequate amounts of organic matter and humus.

Crop Rotation

Crop rotation refers to the sequence of crops and cover crops grown in a specific field. Crop rotation is one of the primary management tools essential to the success of low-input and organic farm systems. Well-planned rotation schedules are designed to manage short-term and long-term fertility, to reduce weed pressure, to disrupt pest and disease cycles, and to optimize crop production. Crop rotation schedules take into account factors such as crop family, plant rooting depths and crop nutrient needs. Rotations often include the use of cover crops, green manures and legumes.

Intercropping, Trap Cropping and Companion Planting

Intercropping, trap cropping and companion planting refer to the growing of two or more crops in proximity

to each other for the benefit of the crop system and/or each other. These practices are used to promote farm biodiversity. Intercropping typically refers to larger-scale, mechanically managed cropping systems with alternating rows or strips of compatible crops. Companion planting usually refers to small-scale planting of vegetable, herb and flower crops selected based on the benefits they provide to neighboring plants. Benefits of companion planting might include providing shade or trellis support, suppressing weeds, providing nutrients, decreasing pest problems, or increasing pollination through the attraction of beneficial insects. Trap cropping is the interplanting of a crop that is more attractive to a pest than the main crop, preventing damage to the cash crop and allowing controlled management of pests on the trap crop. Trap crops can be planted around the perimeter of the cash crop or in strips.

Variety Selection

Crop varieties with pest and disease resistance are the growers' first line of defense in a pest management program. Resistance information can be found on the seed packet or can be obtained from the seller of the seed. Varieties adapted to the Southeast (i.e., heat and humidity tolerant) will also aid in production.

Cover Crops

Cover crops are grown to protect, maintain and enrich the soil. They provide benefits to organic systems that include adding organic matter to soil, encouraging beneficial soil microbes, cycling nutrients, retaining soil moisture, preventing erosion, smothering weeds, and providing habitat for beneficial insects. Selection of legume cover crops can enhance fertility through the fixation of atmospheric nitrogen. When included as part of the crop rotation with primary crops, cover

crops help manage insect pests and weed and disease problems by disrupting their life cycles.

Green Manure

A green manure is a type of cover crop grown primarily to build and maintain soil organic matter. Green manure is often grown for a specific period and then plowed under and incorporated into the soil.

Animal Manures

Animal manure is the most traditional and widely recognized fertilizer used in organic systems. According to the U.S. Department of Agriculture's (USDA) National Organic Program (NOP) standards, raw manure must be applied and incorporated into the soil at least 120 days prior to harvest of a crop that is in direct contact with the soil, such as root and leafy crops. For crops not in direct contact with the soil, such as tomato, okra and corn, raw manure must be incorporated into the soil at least 90 days prior to the harvest. However, due to food safety concerns, the use of raw manure is no longer recommended; the use of composted manure is preferred.

Compost

Compost results from decomposition, where microorganisms break down plant and animal materials into organic material suitable for application to the soil. Composting is one of the best means for handling manure as it stabilizes the nutrients, encourages beneficial organisms, and destroys pathogens and weed seeds. According to NOP standards for compost that uses raw animal manure, the composting process must combine plant and animal materials with an initial C:N ratio of between 25:1 and 40:1. Additionally, according to NOP standards, for in-vessel or static aerated pile systems, the temperature of the composting materials



Rape and crimson clover cover crops



Lady beetle on clover



Bumble bees on zinnia

must be maintained at a temperature between 131 and 170 degrees F for three days. For producers using a windrow system, the composting materials must be maintained at a temperature between 131 and 170 degrees F for 15 days and turned a minimum of five times during this period.

- **C:N Ratio:** Composting microorganisms use carbon (C) as an energy source and nitrogen (N) for building their cell structure. If compost is low in N, the pile will not heat. If compost is too high in N, it may become too hot or go anaerobic, resulting in a foul smell. If there is too much C, decomposition slows. Grass clippings or other green vegetation tends to have a higher proportion of N than brown vegetation, such as dried leaves, straw or wood chips.

Beneficial Insects and Biological Pest Control

Not all insects are pests, and many insects are beneficial. Predators, parasites and pollinators are examples of important beneficial insects. Organic systems rely on populations of beneficial insects to maintain a natural balance between pest and predator species. Creating biodiversity through farmscaping can provide habitat and food sources to support beneficial insects in the farm system.

In addition to encouraging natural populations of beneficial insects on the farm, some of these beneficial insects can be purchased and released to increase biological pest control. Release of these biological controls can be effective particularly in a greenhouse or high tunnel for insect control. Biological pest control measures can help keep pest populations at manageable levels.

Farmscaping

Farmscaping is the practice of creating and maintaining habitat specifically for beneficial insects and other helpful species. Flowering plants are an important component, providing nectar and pollen sources for several species of native bees. Planting a diverse mix of plants will ensure that flowers will be in bloom throughout the season, helping to maintain healthy populations of the beneficials. Leaving areas fallow or piled with soil and gravel can also encourage other important pollinators, known as “ground nesters.” Also, working with the natural features of your farm can enhance habitat for beneficials from microorganisms in the soil to bat populations overhead.

Row Covers

Floating row covers are sheets of spun-bonded polypropylene fabric used to protect crops from insect damage or to provide protection from frost for early- and late-season plantings. Row covers come in a variety of weights and sizes, depending on their intended purpose. Lighter covers are used for insect protection, while heavier covers are used for frost protection.

Conservation Tillage

Conservation tillage is the use of little or no tillage in a crop production system. Excessive tillage aerates the soil and speeds the rate of decomposition, burning up the organic matter and humus reserves in the soil. Reduced tillage leaves crop residues undisturbed on the soil surface for as long as possible, slowing decomposition while providing a steady food source for soil microorganisms. Conservation tillage increases organic matter in the soil, improves soil tilth and ultimately improves soil productivity while reducing soil erosion. Conservation tillage includes practices such as strip-till and no-till planting, where soil disturbance is limited to localized strips or bands to establish plant rows.

Mulches

Mulch is a protective covering overlaid on the ground to suppress weeds, regulate soil temperature, retain soil moisture, and prevent erosion. Mulches provide weed control by smothering weed seedlings and blocking light from the soil surface, preventing the germination of weed seeds. By shading soils in the warm summer months and helping to insulate the soil during cool weather, mulches help to regulate soil temperature. The mulch covering retains soil moisture by preventing water losses through evaporation from sun and wind. Mulch protects the soil from erosion by covering the soil and protecting it from heavy rains. Commonly used mulches include straw, compost, grass clippings, plastic, biodegradable mulch and landscape fabric.

Living Mulches

Living mulches are low-growing vegetative cover crops that are intercropped with cash crops. Living mulches are used to extend cover crop benefits into the growing period of the cash crop. Benefits may include weed control, increased fertility and increased soil moisture. Living mulches may be planted either before or after the cash crop. It is important that the characteristics of the living mulch complement those of the cash crop. Typically, living mulches should germinate and grow in the shade and be low-growing relative to the main crop. Living mulches are not appropriate for all situations. They can compete with cash crop for moisture and nutrients so they are not recommended for low-growing, shallow-rooted or drought-susceptible crops.

Field Sanitation

Field sanitation is the practice of managing crop residues to remove disease vectors, weed seeds and habitat for pests. Sanitation practices may include the removal, burning or deep cultivation of crop residues. Removing diseased or decaying crop residue from the field can greatly reduce and help prevent the spread of disease in a field. Diseased plant material can also be tilled into the soil to prevent the spread of spores in the wind and to hasten the breakdown of the disease pathogen by beneficial fungi and bacteria. Additional sanitation practices include removing weedy habitat that may shelter pests and cleaning equipment to prevent the spread of disease or weed seed from field to field.

Good sanitation practices can go a long way in preventing pest problems. However, some sanitation practices such as clean cultivation, deep plowing and burning may cause erosion, decrease soil organic matter, and reduce biodiversity. Therefore, these practices should be used on a limited basis.

Soil Solarization

Soil solarization is a preplant method for heating the soil to destroy soilborne pathogens and weed seeds. The process involves covering moistened soil with two sheets of transparent plastic, separated by an air space,

for a period of four to six weeks during the hottest part of the summer. The plastic sheeting captures and retains solar energy, raising the temperatures in the soil to levels lethal to many soilborne pests and weed seeds in the top 4 to 6 inches of soil. Maintaining constant soil moisture throughout the solarization process will increase the thermal sensitivity of target organisms, improve heat conductivity, and enable biological activity during the solarization process.

Flame Weeding

Flame weeding is a weed management practice that uses a liquid propane torch to singe young weeds either before or after the germination of the main crop. Flaming is more effective on broadleaf weeds than grasses. With broadleaf weeds, the young weed seedlings are the most susceptible to flame heat before or during the 3 to 5 leaf stage, when they are 1 to 2 inches tall.

Stale Seed Beds

The stale seed bed technique involves preparing the bed several weeks before the crop will be planted. This early preparation allows the first flush of weeds to emerge, as any weed seeds that were disturbed and brought to the soil surface during bed cultivation will germinate. Before the crop is planted, these weeds can be removed through shallow cultivation or flaming, providing a clean bed in which to plant the crop.

No Seed Threshold (NST)

The No Seed Threshold is a weed management strategy based on keeping the farm clean of weeds and weed seeds. Weeds should not be permitted to set seed. Over time, the number of weeds setting seed is reduced, thereby reducing the “weed seed bank” or weed seeds remaining in the field.

For more information on organic and sustainable agriculture practices, visit the the UT Organic and Sustainable Crop Production website at <http://organics.tennessee.edu>, National Sustainable Agriculture Information Service (ATTRA) website at <http://attra.ncat.org> or eOrganic at http://www.extension.org/organic_production.